

YANKEE ATOMIC ELECTRIC COMPANY

Telephone (617) 872-8100
TWX 710-380-7619

1671 Worcester Road, Framingham, Massachusetts 01701

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FYR 85-86

August 12, 1985

Director of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. Hugh L. Thompson, Jr.
Director, Division of Licensing

References: (a) License No. DPR-3 (Docket No. 50-29)
(b) USNRC Generic Letter 85-02, dated April 17, 1985
(c) YAEK Letter to USNRC, dated June 24, 1985

Subject: Response to USNRC Generic Letter 85-02

Dear Sir:

In Generic Letter 85-02 you requested that we respond to several recommendations and questions regarding steam generator tube integrity within 60 days [Reference (b)]. Because we received the letter late, we requested an extension of the time limit until August 12, 1985 [Reference (c)].

Yankee has always recognized that steam generators are important components with respect to the overall reliability of the plant. We have been aware of the importance of a Secondary Water Chemistry Program and the role it plays in maintaining steam generator tube integrity. In November 1968, Yankee was the first commercial Westinghouse nuclear facility to establish all volatile chemistry. Our Secondary Water Chemistry Program is oriented toward maximizing the operating life and availability of the existing steam side components. Yankee has also pioneered the use of eddy current inspection of steam generator tubes and has had an inspection program beyond the minimum requirements since 1970. The results of our aggressive chemistry control and inspection programs has been a 25-year operating history without the significant steam generator tube failures seen by the industry.

We have reviewed your recommendations for improved steam generator tube integrity contained in Generic Letter 85-02. Our detailed responses are attached. In general, we are in agreement with your recommendations, but we believe the recommendations should be applied on a case-by-case basis. In Yankee's case, there has been 25 years of operation without the generic failure mechanisms seen in the industry; the plant operates on an extremely pure mountain river; the steam generators have stainless steel tubing and not inconel; our eddy current inspection program has been more encompassing than required over a 15-year time frame; we have used all volatile chemistry since

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Attention: Mr. Hugh L. Thompson, Jr., Director

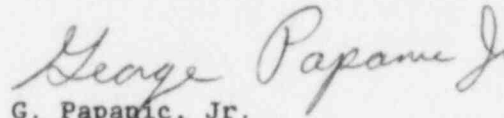
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1968; and finally, we have a proven, successful chemistry control program. Therefore, we do not agree that more stringent Technical Specifications are required. Although rigorous secondary chemistry controls are prudent from the standpoint of protection of investment, they are not necessary for protection of public health and safety and are not appropriate topics for Technical Specifications.

If you have any questions regarding this subject, please contact us.

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY



G. Papanic, Jr.
Senior Project Engineer - Licensing

GP/glw

Attachment

Staff Recommended Actions and Review Guidelines
Stemming from NRC Integrated Program
for the Resolution of Unresolved Safety Issues
Regarding Steam Generator Tube Integrity

Yankee Response:

With regard to the effect of exposure to air, Yankee endeavors to minimize the amount of time that the secondary side of the steam generators are drained and open. Whenever practicable, Yankee keeps the secondary side of the steam generator filled with hydrazine-treated primary grade water.

During the most recent virtual 100% inspections of all four steam generators, Yankee applied the mechanical feasibility criteria with a high degree of success.

NRC RECOMMENDATION - 2.b: INSERVICE INSPECTION PROGRAM (INSPECTION INTERVAL)

The staff recommendation that the maximum allowable time between eddy current inspections of an individual steam generator should be limited in a manner consistent with Section 4.4.5.3 of the Standard Technical Specifications, and in addition, should not extend beyond 72 months, is consistent with actual operating practice at Yankee. We concur with the intent and believe that a change to the Technical Specifications is not necessary.

NRC RECOMMENDATION - 3.a: SECONDARY WATER CHEMISTRY PROGRAM

References

- (a) Workshop Proceedings: Pitting in Steam Generator Tubing EPRI NP3574-SR, October 1984
- (b) The Impact of Makeup Water System Performance on PWR Steam Generator Corrosion EPRI NP-4050 Project 404-1
- (c) NUREG-0844

Yankee Atomic Electric Company (YAEC) has always been aware of the importance of a Secondary Water Chemistry Program (SWCP) and the role it plays in maintaining steam generator tube integrity. In November 1968, Yankee was the first commercial Westinghouse nuclear facility to establish All Volatile Treatment (AVT). This forward thinking approach was not followed by other Westinghouse facilities on a routine basis until 1975. Yankee Atomic maintains a SWCP which is oriented toward maximizing the operating life and availability of the existing steam side components. This aggressive SWCF has resulted in a twenty-five year operating history without the significant failure of major steam cycle components which can be attributed to poor chemistry control.

The chemistry program at YAEC has been developed and modified with time to reflect the materials of construction of the steam cycle components, purity and chemical composition of the secondary cooling water and the inherent operational characteristics of the steam cycle components. This program is proceduralized and emphasizes the use of key control parameters, such as oxygen concentration in the condensate and cation conductivity, chloride concentration and pH in the continuous steam generator blowdown. Limits are imposed upon these parameters with power reduction actions indicated if the limits are exceeded for established time periods. If specifications are exceeded, emphasis is placed on corrective actions which address the source for the out-of-specification parameter (e.g., correction of condenser air in-leakage or condenser cooling water ingress) versus symptom masking measures, such as increased blowdown from the steam generators. These procedural guidelines are implemented by a chemistry staff whose knowledge of the Yankee plant operational characteristics stems from seventy man-years of experience in the Yankee organization. The chemistry manager advises station management of the status of the secondary chemistry and recommends corrective actions if necessary.

The chemistry program and its associated limits have been based on the materials affected by secondary cooling water and the purity of that water. The main condenser tube material is predominantly admiralty brass with the exception of the air removal sections which have been retubed with 304 stainless steel. This limited retubing has halted tube failures in high ammonia concentration regions of the condenser. Ammonia concentration limits have been set to minimize corrosion in the admiralty brass region of the condenser. The feedwater heater tubes are constructed of 90/10 copper/nickel alloy (Feedwater Heater Number One) and admiralty brass (Feedwater Heater Numbers Two and Three). Ammonia and dissolved oxygen concentration limits have been set to minimize corrosion of copper in these tubes. The results of inspections on these feedwater heaters indicate the primary mode of tube degradation is vibration. The tubes of the steam generator are Type 304 stainless steel, 3/4 inch O.D. and 0.072 inch average wall thickness. This material, as fabricated and installed at Yankee, and under our chemistry program, has exhibited no denting and limited thinning and pitting as corrosion phenomena. Extensive eddy current testing on the steam generator tubes has shown denting to be a minor and random phenomenon.

Thinning of steam generator tubes was halted with the introduction of AVT chemistry. Pitting corrosion mechanisms account for the majority of the tube defects. The SWCP limits have been established to ensure an operating chemistry which minimizes the presence of contaminants linked to pitting corrosion [Reference (a)]. During our twenty-five year operational history, a total of 248 tubes (encompassing cold and hot legs) have been plugged in the four steam generators. This plugging record has resulted from a nearly one hundred percent eddy current testing of all four generators and places Yankee in the clean category [Reference (c)]. Yankee's tube plugging criteria stipulates plugging at greater than forty percent degradation. It is worth noting that the remaining undegraded wall thickness is nearly equivalent to the total tube wall thickness of later generation facilities.

Corrosion mechanisms are generally aggravated by ionic contaminant ingress through cooling and makeup waters and air in-leakage through a variety of mechanisms. The location of Yankee on the Deerfield River takes advantage of the high purity of this cooling water to minimize the ingress of ionic impurities into the steam generators. A recent EPRI study [Reference (b)] reviewed the makeup and source water terms for eight fresh water sites in an attempt to correlate impurity ingress through the makeup cycle with corrosion mechanisms within the steam generators. No correlation was evident. Analyses of the Yankee secondary cooling water determined generally lower levels of contaminants than the majority of the eight fresh water source terms evaluated. Operating with such high purity secondary cooling water mitigates the impact of cooling water in-leakage through the condenser. The Yankee SWCP imposes limits which, under normal operating conditions, will detect cooling water in-leakage before such leakage can adversely impact the steam generators. Yankee routinely operates with air in-leakage less than 1CFM. Control limits are imposed upon the dissolved oxygen concentration and actions are taken to evaluate air in-leakage when the limits are exceeded.

NRC RECOMMENDATION - 3.b: CONDENSER INSERVICE INSPECTION PROGRAM

A condenser inservice inspection program has been a part of the Yankee Atomic Electric Company (YAEC) preventative maintenance program since 1977. This program involves eddy current testing (ECT) of selected tubes in the two water

boxes of the main condenser. These inspections are conducted at predetermined intervals based upon the results of previous ECT. Changes in the schedule may be recommended based upon tube plugging which may occur between scheduled eddy current inspections.

The results of this inspections program are evaluated against preset criteria and are used to establish which, if any, tubes require plugging. A record of plugged tubes is maintained and evaluated in conjunction with any postulated damage mechanism for trending purposes. The evaluation of condenser tube integrity between schedule ECTs is accomplished through the Secondary Water Chemistry Program (SWCP). This program is further outlined under the response to Staff Recommendation 3.a. The limits established by the SWCP have been designed to minimize the corrosion potential of condenser cooling water or air in-leakage. Suspected in-leakage pathways are monitored at levels below the established limits until quantifiable leakage estimates are obtained. Plant management is subsequently informed of these estimates and, if required, established a planned power reduction to facilitate necessary repairs. Verified water or air in-leakage is located in accordance with established operational procedures. Standard industry practices are used for tube plugging and mechanical repairs related to correction of air in-leakage.

NRC RECOMMENDATION - 4: PRIMARY TO SECONDARY LEAKAGE LIMIT

Yankee Response:

Yankee's Technical specifications are equivalent to the Westinghouse Standard Technical Specifications with the exception of a 500 gpd per generator limit. Our limitations are adequate and allows Yankee the flexibility to assess the leakage rate and coolant activity levels in conjunction with our specific steam generator failure mechanism before taking action. It is and has been Yankee policy to closely assess steam generator performance and take conservative action including fixing tube leakage prior to the recommended 500 gpd limit.

NRC RECOMMENDATION - 5: COOLANT IODINE ACTIVITY LIMIT

Yankee Response:

The iodine activity limits in current Yankee Technical Specifications are identical to those in the Westinghouse Standard Technical Specifications. Our reactor coolant pump trip criteria is under review but will be implemented to ensure that if off-site power is retained, no loss of forced Main Coolant System flow will occur for SGTR events up to and including the design-basis double-ended break of a single steam generator tube. Yankee also has main coolant loop isolation valves and procedures are in place to use them for isolation of the steam generators in the event of a tube rupture. This will assure isolation within the time limit assumed by the off-site dose analysis.

NRC RECOMMENDATION - 6: SAFETY INJECTION SIGNAL RESET

Yankee Response:

The design of Yankee is such that the LPSI and HPSI pumps take their suction initially from the Safety Injection Tank (i.e., RWST) and not the boric acid storage tank. The concern is not applicable to the Yankee plant.

ENCLOSURE

Request for Information Concerning Category C-2
Steam Generator Tube Inspections

Yankee Response:

Since 1977, Yankee has had an aggressive policy for eddy current testing steam generators. Inspections include all available tubes within reach of a test setup using our Zetec polar positioner. This has resulted in better than 90% coverage of all steam generators inspected. This policy is applied for our own interest and has produced a sound basis for understanding the degradation mechanism, its rate of progression and its non-potential for leading to tube rupture before leak.

In the course of assessing eight virtual 100% inspections, Yankee has had the opportunity to interact with the STS Category System and found it lacking. Basically the 3N% sample size is too small to produce meaningful results. For illustration, with a strict 3N% sample (= 195 tubes):

0 Defects = C-1

1 Defect = C-2

2 Defect = C-3

This system can produce unnecessary and unwarranted results. On one hand the STS requirement to include all previous indications and the most probably areas of degradation in the first sample tends to elevate the results. On the other hand, ALARA would indict a system which, for two minor defects could cause an extra 60 man-rem of exposure.

However, when based on large samples, the STS Category System dictates reasonable and prudent minimum responses. When and whether Yankee would extend the steam generator inspections would depend upon the underlying cause for any given problem. Little benefit and significant exposure and expense would accrue if C-2 conditions were to lead automatically to a C-3 response. Yankee is well equipped to make good engineering judgements of test results and should be allowed the flexibility to determine the amount and extent of further testing.